


Science, Service, Stewardship




**Fish Bypasses at
Water Diversions**

Larry Swenson, P.E.
Hydraulic Engineer , NOAA Fisheries

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Introduction

GOAL: Return Fish Quickly and Safely to the River

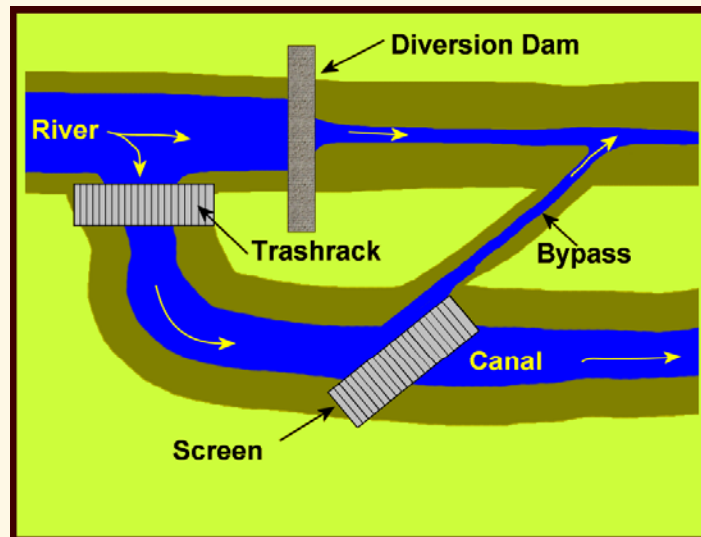
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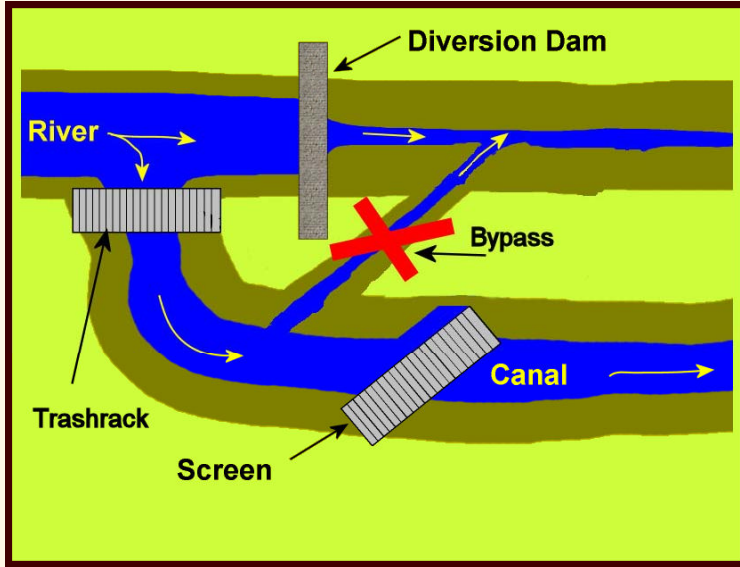
Introduction

GOAL: Return Fish Quickly and Safely to the River
Screen and Bypass Work in Tandem

Bypass Location



Bypass Location



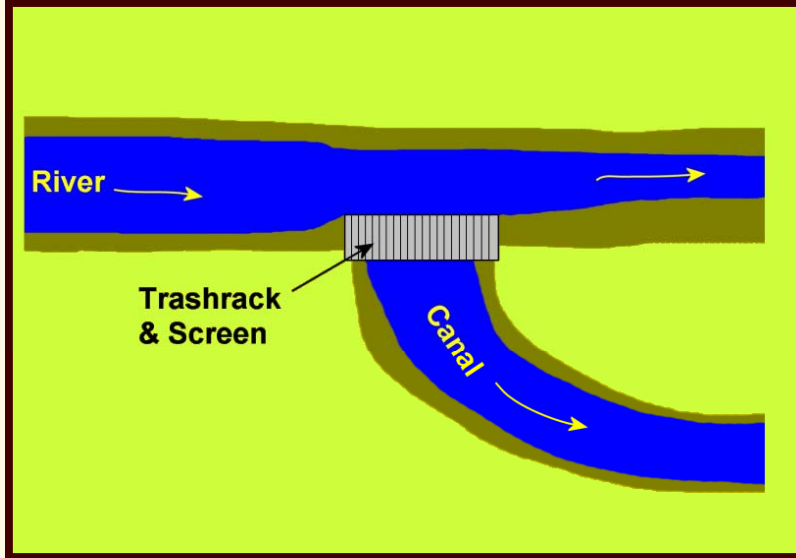
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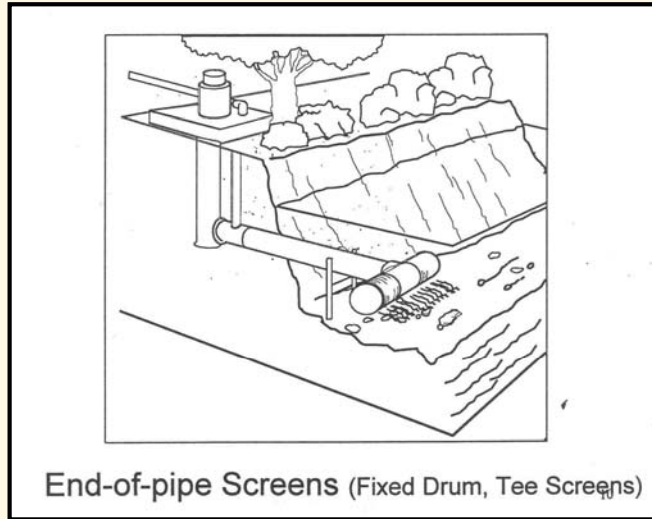
Introduction

Some screen layouts eliminate need for a separate bypass system.

No Bypass Needed!



End-Of-Pipe Screens



Fixed Cylinder Screens



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Juvenile Behavior

Optimum Design

—Combines Biology and Engineering

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Juvenile Behavior

Optimum Design

- **Avoidance / Attraction**
 - **Visual, Touch, Hydraulic Changes, Spatial**

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Juvenile Behavior

Optimum Design

- Avoidance / Attraction
- **Swimming Speed**
 - **Sustained speed (minutes)**
 - **Length of screen**
 - **Number of bypasses required**
 - **Design for adverse water quality**

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Juvenile Behavior (con't)

—**Lighting Conditions**

- **Intensity**
- **Mercury Vapor Lights**
- **Strobes**
- **Clean Surface / Turbidity**
- **Avoid Darkness**

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Juvenile Behavior (con't)

—Lighting Conditions

—**Hydraulic Changes**

- **Acceleration and Deceleration**

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Juvenile Behavior (con't)

- Lighting Conditions
- Hydraulic Changes
- Holding Tendencies**
 - **Low velocity zones (predators)**
 - **Delay (smoltification)**
 - **Entrainment Risk**

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Juvenile Behavior (con't)

- Lighting Conditions
- Hydraulic Changes
- Holding Tendencies
- Conclusions**

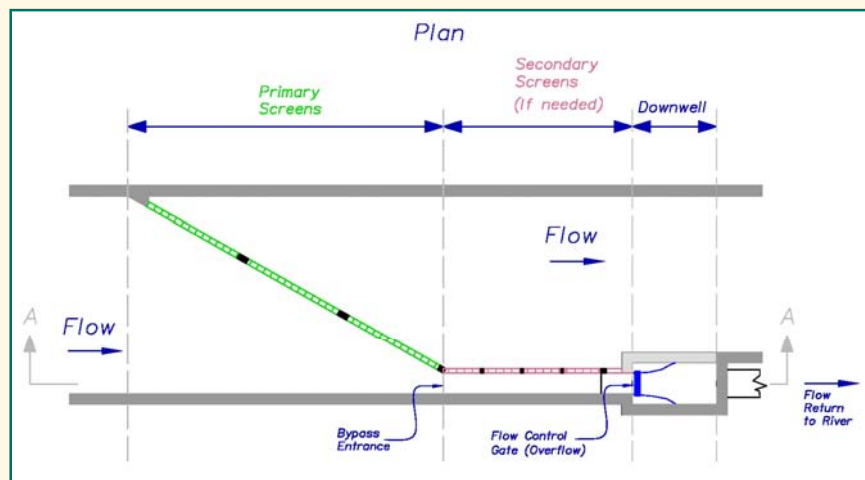
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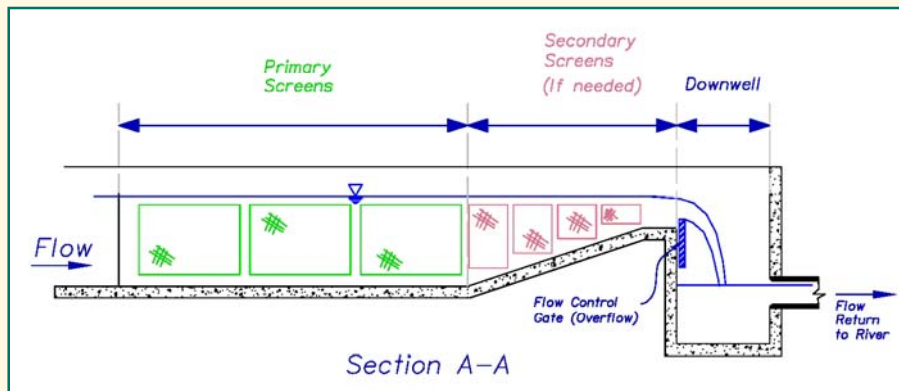
Components of the Bypass

- Entrance
- Conveyance System
- Outfall

Bypass Entrance - Plan



Bypass Entrance - Section



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Bypass Entrance

- Old Screen Design Problems
- Adequate bypass size and flow
- Entrance slot
- Entrance slot velocity
- **Intermediate bypass**
 - **Secondary screens and pumpback**

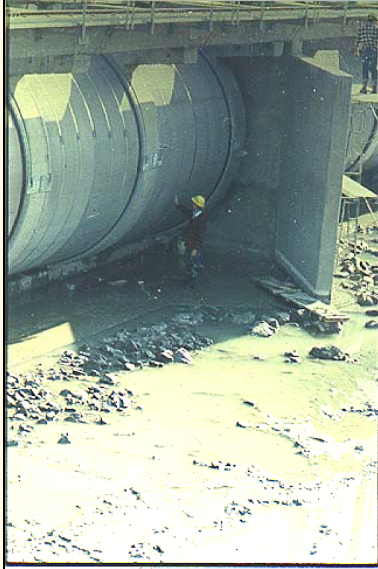
Old Screen Design



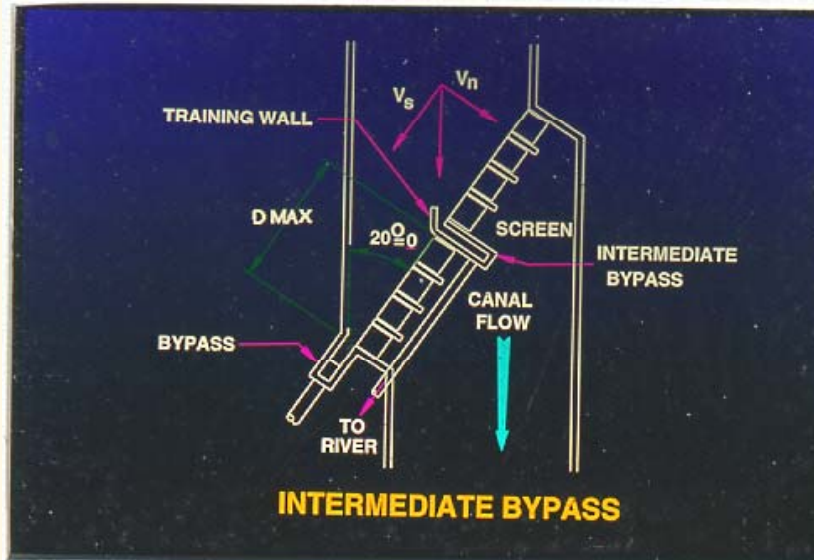
Old Screen Design Bypass Entrance



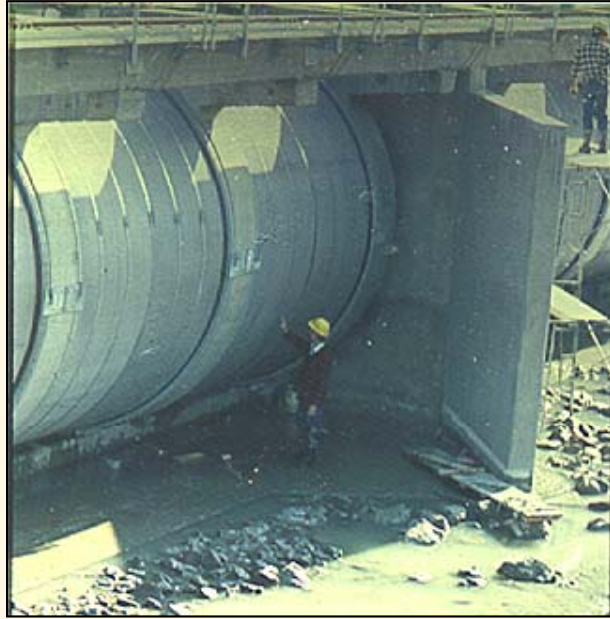
Full-Depth Slots



Intermediate Bypass



Intermediate Bypass



White River Bypass Entrance



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Bypass Conveyance System

- **General**
 - Open-topped bypass (including downwell)
 - Maintain 2 ft width
 - Use ramp to gradually increase velocity
 - Secondary screens
 - Minimum depth over bypass weir is 1 ft

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Bypass Conveyance System

General

Downwell design

- Energy Dissipation
- Rapidly move fish through this area
- Pipe entrance and invert

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Bypass Conveyance System

General

Downwell design

Pipe criteria

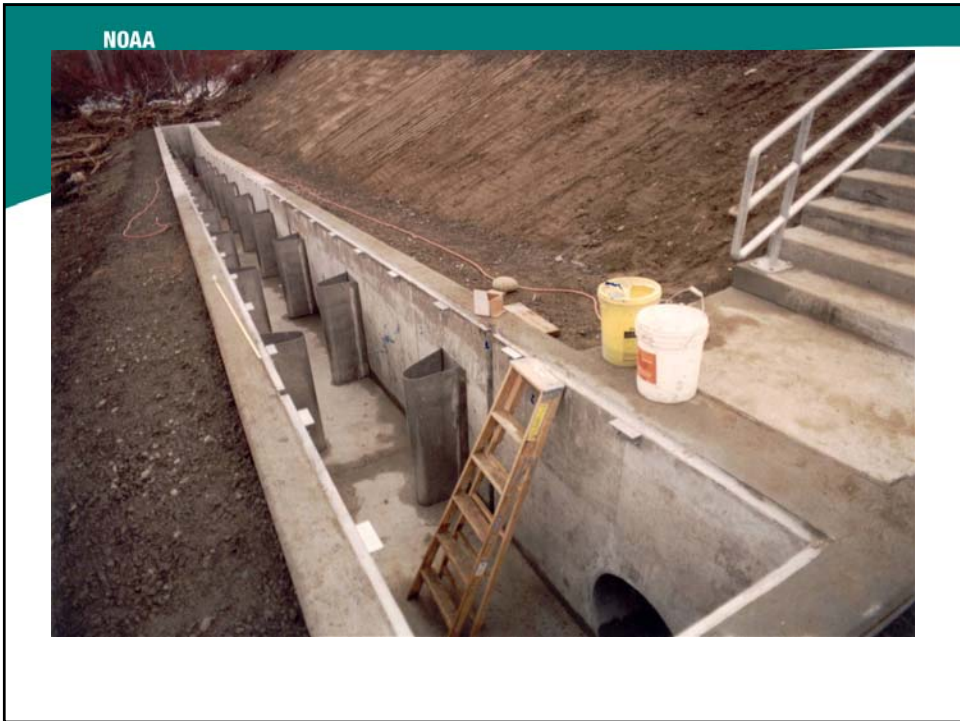
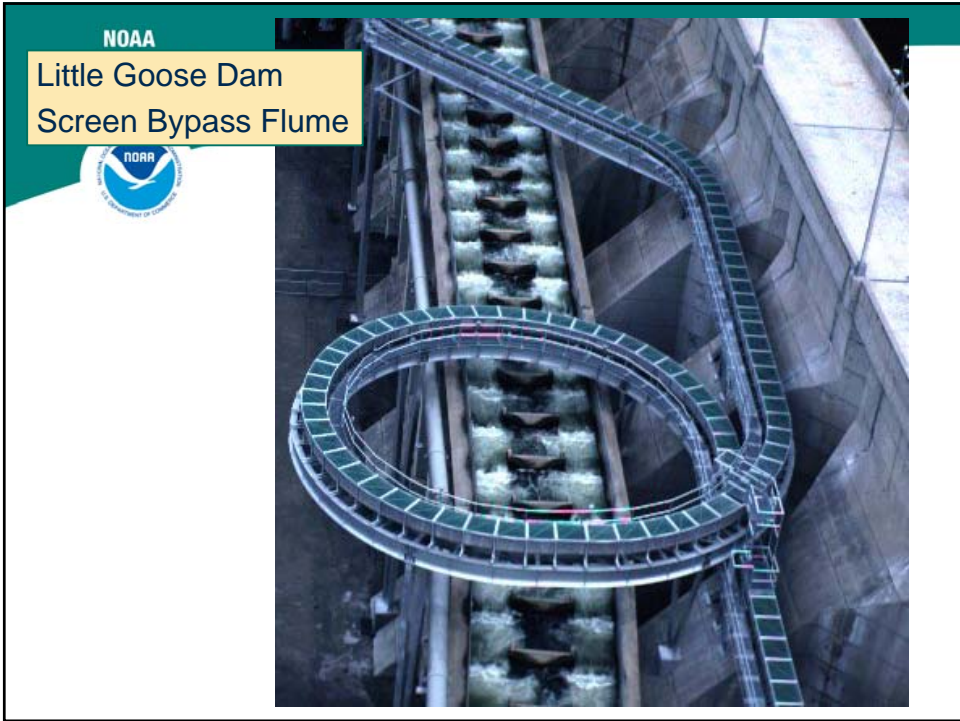
- Full pipe or open channel flow
- Avoid closure valves
- Smooth pipes and joints
- Pipe diameter
- Flow velocity

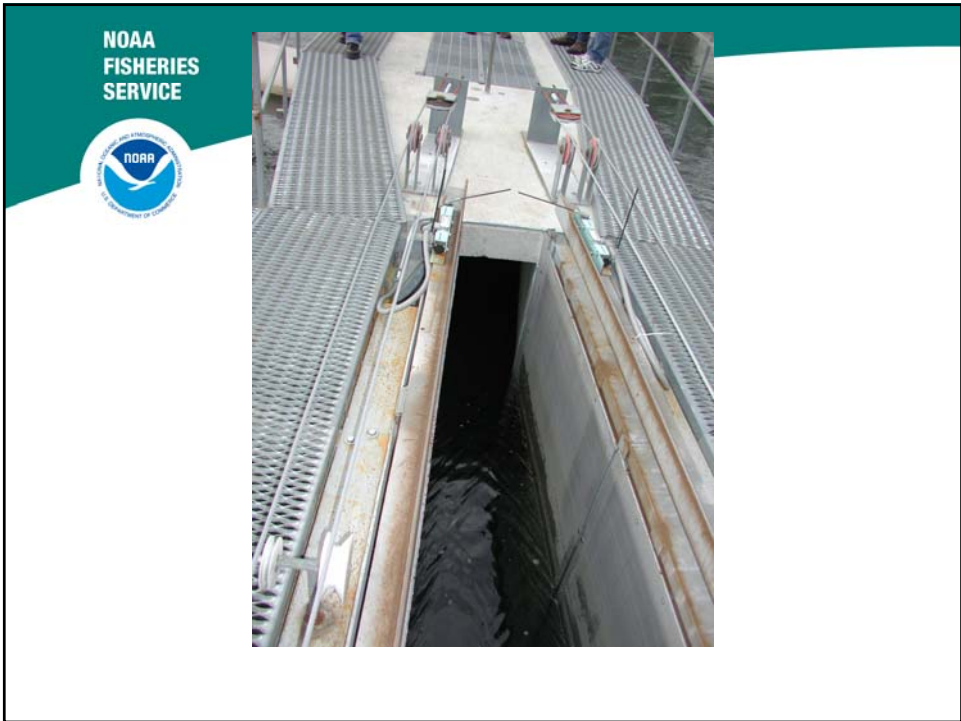
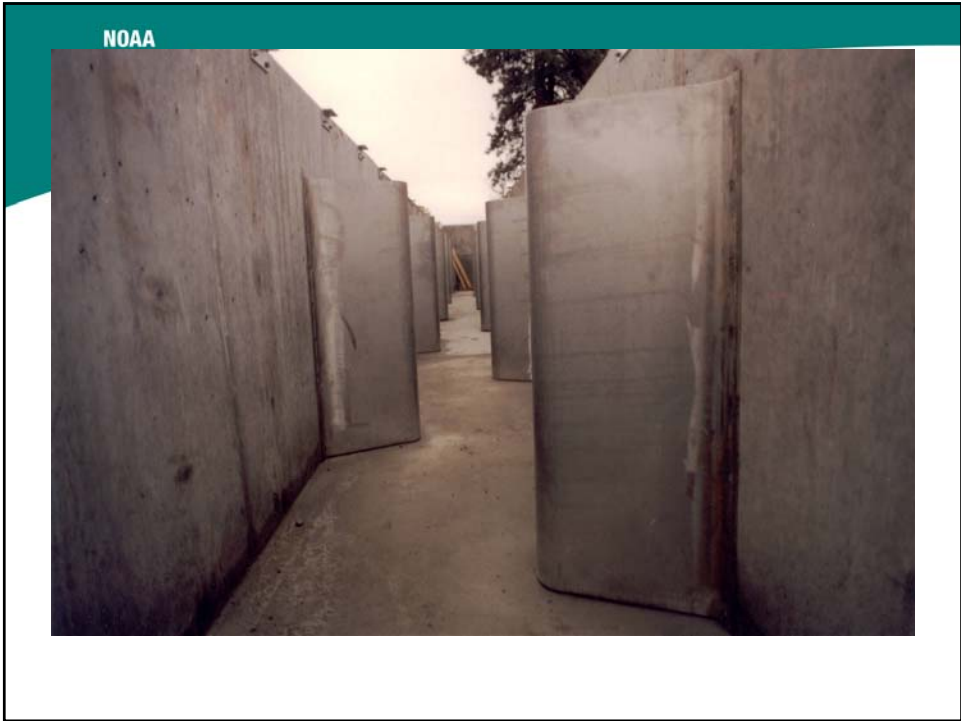
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Bypass Conveyance System

- General
- Downwell design
- ***Pipe criteria (con't)***
 - Alignment
 - Avoid negative pressures
 - No hydraulic jumps
 - Sample facilities
 - Access for inspection
 - Properly compacted fill







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Bypass Conveyance System

- General
- Downwell design
- Pipe criteria
- Avoid pumping fish/bypass flow***

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Bypass Outfall

Concerns

- Minimize predation
- Minimize disorientation of juveniles
- Minimize impact on adults
- Bypass releases into open channels which return to the river

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Bypass Outfall

Concerns

Submerged versus Elevated outfalls

- Advantages and Disadvantages
- Alternative design

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Bonneville Dam Outfalls Old versus New



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Bypass Outfall

- Concerns
- Submerged versus Elevated outfalls
- **Design Criteria**
 - Ambient velocity ≥ 4 fps
 - Minimize air entrainment (submerged outfall)
 - Minimize predator holding areas (eddies)
 - Maximum impact velocity = 25 fps
 - Outfall egress
 - Avian protection

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Bypass Outfall

Concerns

Submerged versus Elevated outfalls

Design Criteria

Energy Considerations

- Too much hydraulic head
- Too little hydraulic head
- Mid-range

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White River Outfall



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Bypass Outfall

- Concerns
- Submerged versus Elevated outfalls
- Design Criteria
- Energy Considerations
- ***Bypass Outfall design options***
 - Locate close to point of diversion
 - Locate in areas with sufficient flow
 - Induced high ambient velocity
 - Trade offs to hardening the outfall

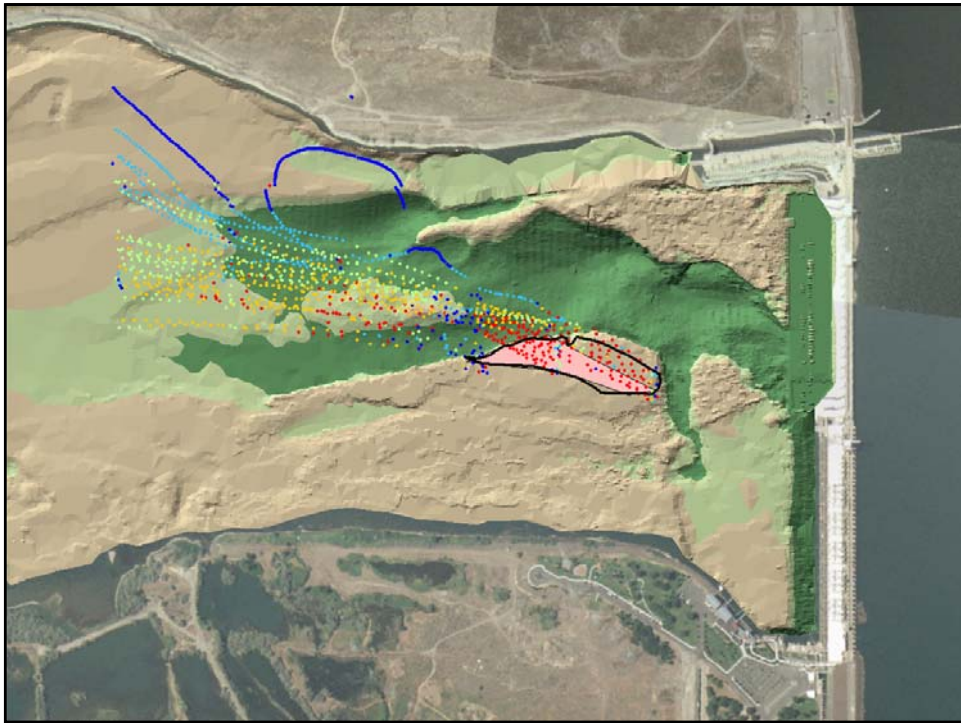
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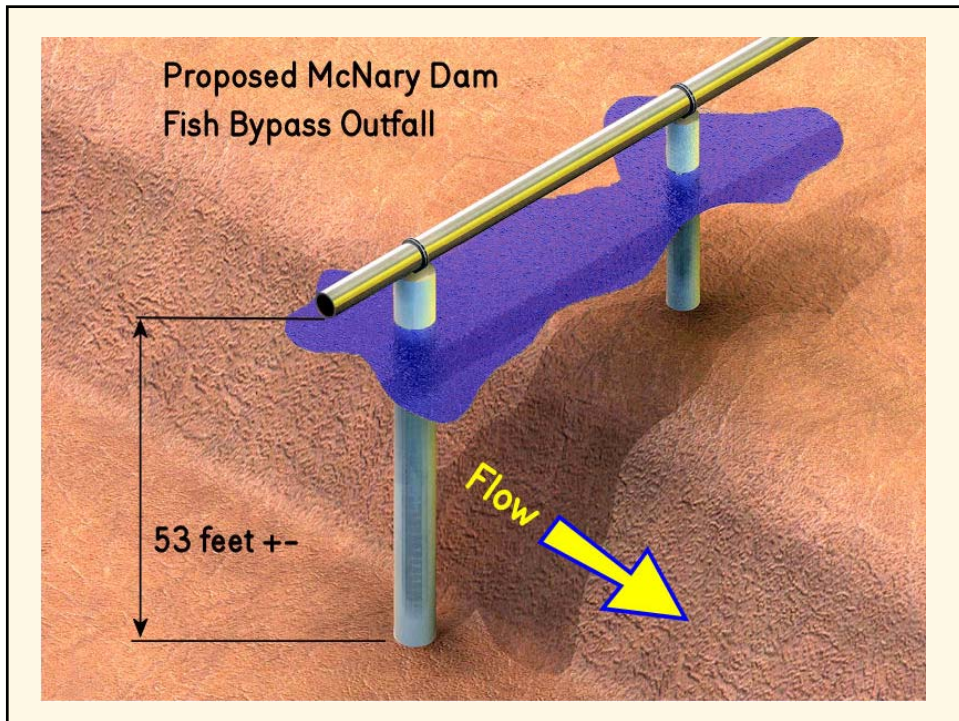
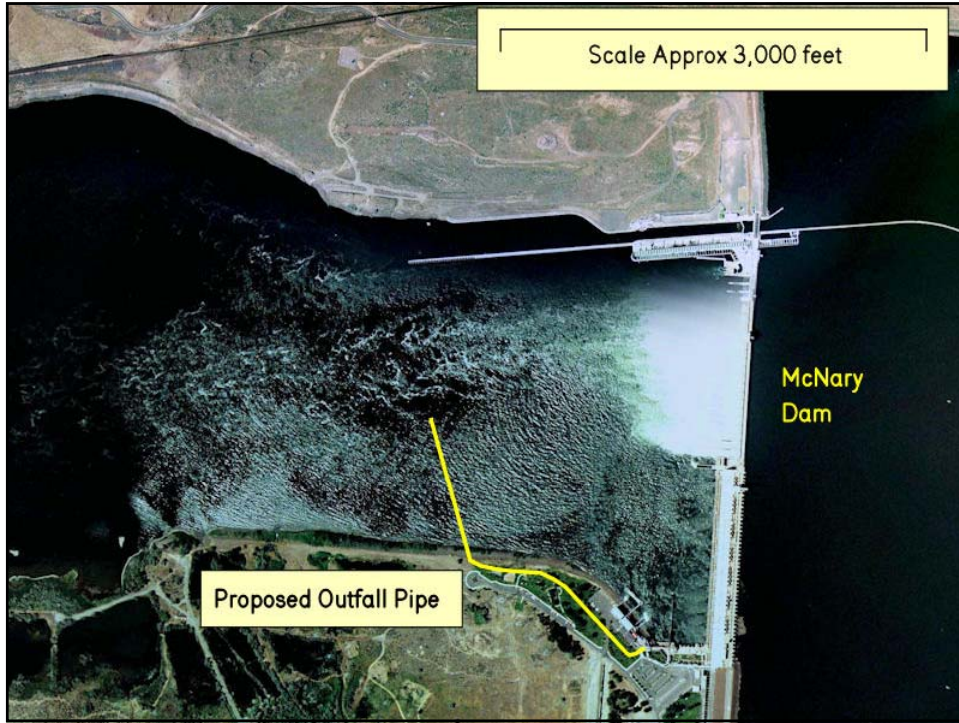


Stanfield Outfall









Lower Monumental Dam

